

REMARKS

It is respectfully requested that the Examiner enter these amendments prior to examining the application on its merits.

Respectfully submitted,

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CLAIMS

1. A screen printing head for applying a pasty product to a printing screen, comprising:
a main body;
wiper blades disposed to the main body for contacting a printing screen;
a first chamber providing a reservoir for containing a supply of pasty product, the first chamber being defined at least in part by the main body and including at least one outlet opening through which pasty product is in use forced under pressure;
a second chamber in fluid communication with the at least one outlet opening, the second chamber being defined in part by the main body and the wiper blades and being in use in communication with the printing screen; and
a flow director disposed in the second chamber and configured such as in use to cause a circulatory flow of pasty product contained therein which passes over the surface of the printing screen and a flow of pasty product towards the printing screen which acts to force pasty product of the circulatory flow towards the printing screen and into apertures therein.
2. The printing head of claim 1, wherein the at least one outlet opening comprises an elongate slot.
3. The printing head of claim 1 ~~or 2~~, wherein the flow director is further configured such as to define first and second circulation zones in which pasty product is locally circulated and through which the circulatory flow is directed.
4. The printing head of ~~any of claims 1 to 3~~, wherein the flow director comprises vanes, with the circulatory flow in use passing beneath the lower edges of the vanes.
5. The printing head of claim 4, comprising first and second vanes disposed on opposed sides of the at least one outlet opening, with the lower edges of the vanes defining a nozzle directed towards the printing screen.
6. The printing head of claim 5, wherein the nozzle is an elongate nozzle.
7. The printing head of ~~any of claims 1 to 6~~, wherein the main body includes first and second lobe members which in part define the second chamber, the lobe members being disposed above respective ones of the wiper blades and having arcuate lower surfaces so as to promote the circulatory flow.

8. The printing head of ~~any of claims 1 to 7~~, wherein the main body includes one or more ports through which the first chamber can be charged with pasty product.
9. The printing head of ~~any of claims 1 to 7~~, wherein the main body includes a replaceable cassette which defines at least in part the first chamber, the first chamber being charged by replacement of the cassette.
10. The printing head of ~~any of claims 1 to 9~~, wherein the wiper blades comprise flexible wiper blades.
11. A screen printing apparatus comprising the printing head of ~~any of claims 1 to 10~~.
12. A method of screen printing using a screen printing head including a chamber in communication with the printing screen, comprising the steps of:
providing a circulatory flow of pasty product in the chamber which passes over the surface of the printing screen; and
providing a flow of pasty product towards the printing screen which acts to force pasty product of the circulatory flow onto the printing screen and into apertures therein.
13. The method of claim 12, further comprising the step of locally circulating pasty product in first and second circulation zones through which the circulatory flow is directed.
14. ~~(deleted). A screen printing head for screen printing, through which printing head pasty product to be printed can be pressed by applied pressure, comprising a chamber into which pasty product can be charged and in which the same can be placed under pressure, an exit slot from the chamber for pasty product to be printed and a downstream chamber in communication with the exit slot, wherein the downstream chamber is closed at an exit end thereof in use by flexible wiper blades and by a portion of a screen through which the pasty product is to be printed, and the downstream chamber is subdivided by vanes to define pasty product flow paths along which pasty product will flow as a result of movement of the printing head over the stencil in use, the flow paths comprising circulating flow above the wiper blades and flow towards the stencil between the vanes as a result of the circulating flows and movement of the pasty product through the exit slot due to the applied pressure.~~
15. ~~(deleted). A method of screen printing using a printing head, through which printing head pasty product to be printed is pressed by applied pressure, comprising the steps of charging pasty product into a chamber and placing the same under pressure for~~

movement towards an exit slot from the chamber and into a downstream chamber in communication with the exit slot, the downstream chamber being closed at an exit end thereof by flexible wiper blades and by a portion of a screen through which the pasty product is to be printed, subdividing the downstream chamber by vanes to define pasty product flow paths along which pass product flows as a result of movement of the printing head over the stencil, the flow paths comprising circulating flow above the wiper blades and flow towards the stencil between the vanes as a result of the circulating flows and movement of the pasty product through the exit slot due to the applied pressure.

conjunction with the adhesion of the pasty product 2 to the stencil 3 causes the pasty product 2 to roll across the stencil 3 as depicted by arrows 6, thereby shear thinning the pasty product 2.

There are many problems associated with this screen printing technique. One problem is that exposure of the pasty product 2 to the atmosphere results in evaporation of the solvents of the pasty product 2 and hence drying of the pasty product 2. Another problem is that increasing the speed of the squeegee 1 to increase the downward force F_2 which forces the pasty product 2 into the apertures 4 of the stencil 3, not only reduces the time available to fill the apertures 4, but can also cause the pasty product 2 to slide across the stencil 3, thereby reducing the rolling effect and hence the shear thinning.

Screen printing heads have been proposed, for example as disclosed in US-A-4622239, which enclose the pasty product to overcome the problems of evaporation, but these printing heads have not addressed the problem of setting a suitable print speed.

WO-A-⁹⁶~~90~~/20088 discloses a screen printing head which attempts to overcome both the problems of evaporation and the setting of the print speed by applying a pressure directly to the pasty product. However, this printing head does not provide for a rolling action of the pasty product and hence shear thinning of the same. Furthermore, this printing head requires a very high pressure to be applied to the pasty product. This high pressure can result in the separation of the metallic and flux components of solder pastes which results in inconsistent printing.

WO-A-98/16387 discloses a screen printing head which has been developed partially in response to the known problems of evaporation and the setting of the print speed. As illustrated in Figure 2, this printing head comprises a main body 10, first and second wiper blades 11, 12, which contact a stencil 13 and together with the main body 10 define a chamber 15 containing a pasty product 16, a grille 17 located at the lower end of the main body 10, and a piston 18 for applying a downward force F_2 on the pasty product 16. The stencil 13, which includes a plurality of apertures 19, is located above a circuit board 20

~~The present invention further provides a printing head for screen printing, through which printing head pasty product to be printed can be pressed by applied pressure, comprising a chamber into which pasty product can be charged and in which the same can be placed under pressure, an exit slot from the chamber for pasty product to be printed and a downstream chamber in communication with the exit slot, wherein the downstream chamber is closed at an exit end thereof in use by flexible wiper blades and by a portion of a screen through which the pasty product is to be printed, and the downstream chamber is subdivided by vanes to define pasty product flow paths along which pasty product will flow as a result of movement of the printing head over the stencil in use, the flow paths comprising circulating flow above the wiper blades and flow towards the stencil between the vanes as a result of the circulating flows and movement of the pasty product through the exit slot due to the applied pressure.~~

~~The present still further provides a method of screen printing using a printing head, through which printing head pasty product to be printed is pressed by applied pressure, comprising the steps of charging pasty product into a chamber and placing the same under pressure for movement towards an exit slot from the chamber and into a downstream chamber in communication with the exit slot, the downstream chamber being closed at an exit end thereof by flexible wiper blades and by a portion of a screen through which the pasty product is to be printed, subdividing the downstream chamber by vanes to define pasty product flow paths along which pass product flows as a result of movement of the printing head over the stencil, the flow paths comprising circulating flow above the wiper blades and flow towards the stencil between the vanes as a result of the circulating flows and movement of the pasty product through the exit slot due to the applied pressure.~~

A preferred embodiment of the present invention will now be described hereinbelow by way of example only with reference to the accompanying drawings, in which:

Figure 1 illustrates a sectional view through a squeegee as employed in a traditional screen printing technique;